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APPLICATION NOTES FOR THE PDS 1020 COMPUTER

MECHANICAL AND ELECTRICAL

ELECTRICAL

NO.	SUBJECT
E1	RLC Circuit Impedance and Phase Angle
E2	Least Squares Curve Fit
E3	RC Filter Response
E4	Chebishev Filter Response
E5	Numerical Solution of a First Order Differential Equation
E6	RC Filter Step Response
E7	Butterworth Filter Attenuation Curve
E8	Gaussian Error Curve
E9	RL Circuit Analysis

MECHANICAL

M1	Convergent Nozzle
M2	Beam Deflection by Numerical Integration
M3	Nuclear Reactor Heat Generation
M4	Centrifugal Compressor
M5	Dynamics - Flywheel Shaft Stress
M6	Spur Gear Design
M7	Mechanics - Experimentally Determining the Coefficient of Kinetic Friction
M8	Mechanics - Helical Spring Design
M9	Mechanics - Static Stress Analysis
M10	Gear Design - Trochoidal Fillet

PDS DIGITAL COMPUTERS

Least squares; curve fit... Chebishev filter response... RC filter response... Gaussian error curve...

Sound familiar? Chances are pretty good that you're spending a lot of good creative engineering time in the tedious, routine solution of problems of this type. Would you be interested in cutting this problem solving time to a mere fraction?

Take a good look at the attached application notes. Compare the simplicity of solution with the method you're now using... slide rule, log tables, calculator, computer center. We don't care how you're doing it. The PDS 1020 computer can cut your routine computation time.

Enter the problem solving steps and variables through the keyboard or high speed tape reader using every day mathematical terms, not machine language. No special training required. No need to learn FORTRAN, COBOL or any other artificial computer language. Answers are immediately available typed out at 15 characters per second. It's just that simple.

Still not convinced? Then return the enclosed reply card and we'll send you more.

Sincerely,

PACIFIC DATA SYSTEMS, INC.

Ronald S. Barbre
Marketing Coordinator

RSB:sfr

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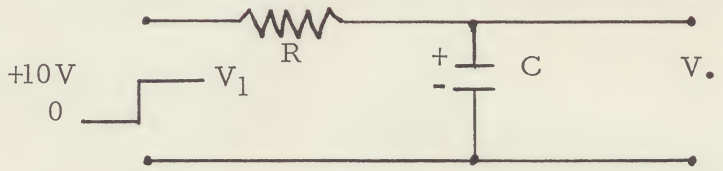
APPLICATION NOTE NO. 6

RC FILTER RESPONSE

GIVEN: An RC filter with an initial charge on the capacitor.



FIND: Evaluate and plot the output voltage response for a step input.

SOLUTION:

V_1 = 10 volt step

R = 1 K ohms

C = 10 microfarad

V_c = 5 volts

$V_o(t) = V_1 (1 - e^{-t/RC}) + V_c$

so,

$V_o(t) = 10 (1 - e^{-t/.01}) - 5$

Plot this function from t = 0 to t = .03 seconds in increments of .001 seconds.

Plot reference lines at VR_1 = 0 volts, VR_2 = -2 volts, and VR_3 = +5 volts.

Use Interpreter PR 5464 with Plotting Instruction

File No. 20-02-09

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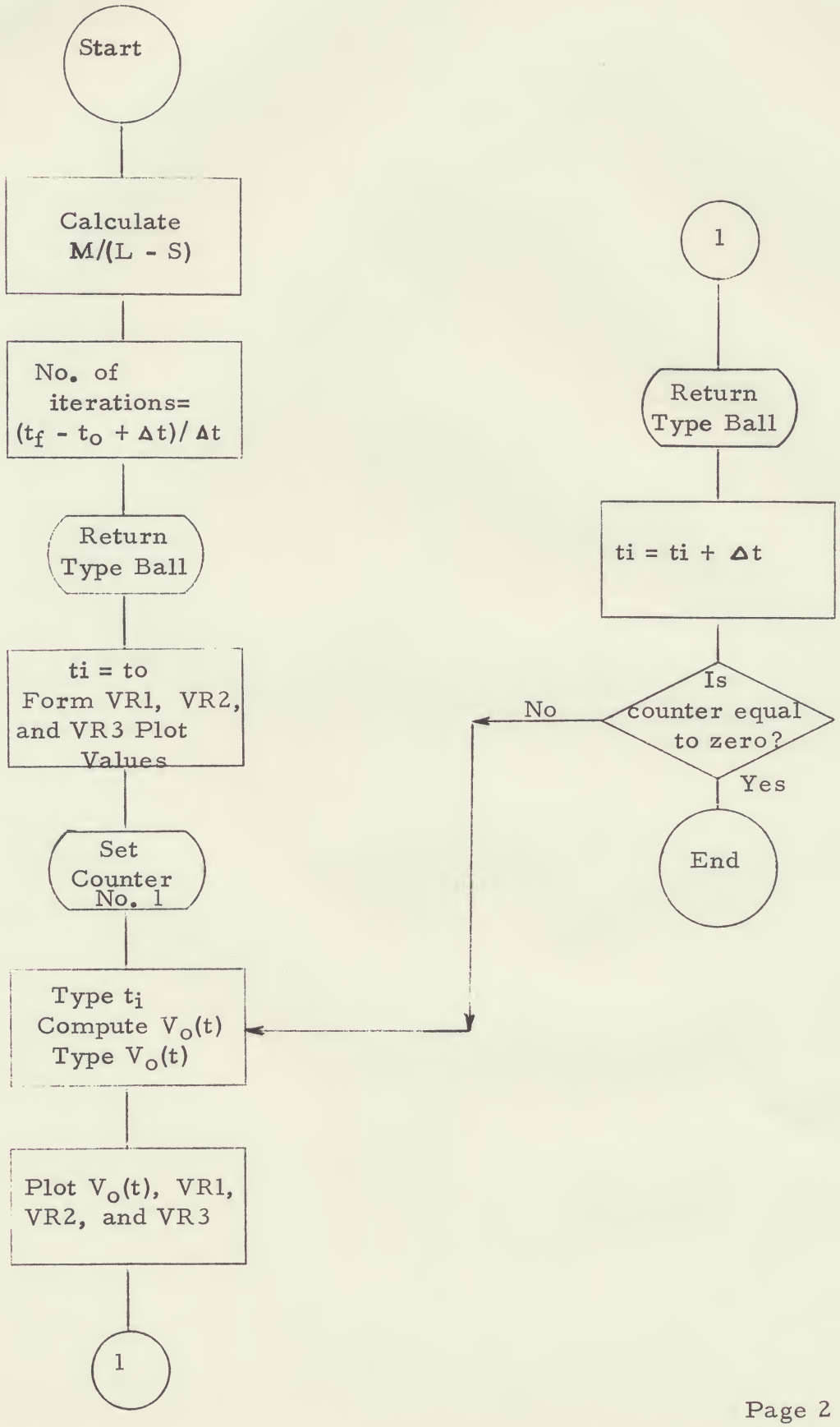
Start
Calculate M/(L - S)
No. of iterations= $(t_f - t_o + \Delta t)/\Delta t$
Return Type Ball
ti = to
Form VR1, VR2, and VR3 Plot Values
Set Counter No. 1
Type t_i
Compute $V_o(t)$
Type $V_o(t)$
Plot $V_o(t)$, VR1, VR2, and VR3
1
1
Return Type Ball
ti = ti + Δt
Is counter equal to zero?
No
Yes
End

PDS 1020 INTERPRETER

PLANNING SHEET

PROGLEM: RC FILTER RESPONSE

$$V_0(+) = V_1 (1 - e^{- +/RC}) + V_c$$

STEP NO.	OPERATION	COMMENT
	Retain 1+	
1	Execute 3+	Key in data
2	L 3 Go	Vc
3	4 -	|Vc| absolute value
4	C 14 Go	
5	L 0 Go	vl
6	S 14 Go	Vl - |Vc| = L
7	S 3 Go	L - Vc = L - S
8	C 14 Go	
9	L 10 Go	M
10	D 14 Go	M/(L - S)
11	C 15 Go	
12	L 5 Go	iF
13	S 4 Go	tF - t0
14	A 6 Go	tF - t0 + dt
15	D 6 Go	(tf - t0 + dt)/dt
16	C 14 Go	= count
17	D +	Return type ball
18	L 4 Go	t0
19	C 16 Go	ti = t0
20	L 7 Go	VR1
21	S 3 Go	
22	M 15 Go	
23	C 7 Go	VR1 Plot Value
24	L 8 Go	VR2
25	S 3 Go	
26	M 15 Go	
27	C 8 Go	VR2 Plot Value
28	L 9 Go	VR3

SCRATCHPAD ASSIGNMENTS

NO.	SYMBOL	CONTENTS
0	Vl	
1	R	
2	C	
3	Vc	
4	t0	
5	tF	
6	dt	
7	VR1	
8	VR2	
9	VR3	
10	50 = M	
11	-1	
12	+1	
13	+10.0	
14	Temp. Storage	
15	M/(L - S)	
16	ti	
17	RC	

PDS 1020 INTERPRETER

PLANNING SHEET

STEP NO.	OPERATION	COMMENT	SCRATCHPAD ASSIGNMENTS NO.	SYMBOL	CONTENTS
29	S 3 Go				
30	M 15 Go				
31	C 9 Go	VR 3 Plot value			
32	L 1 Go	R			
33	M 2 Go	RC			
34	C 17 Go				
35	1 14 +	Set Counter No. 1			
36	L 16 Go	t			
37	TYPE	Type t			
38	Exc. 2+	Vo(t)			
39	TYPE	Type Vo(t)			
40	S 3 Go	Vo(t)-s			
41	M 15 Go				
42	2 2 1C Go	Tab Plot Vo(t)			
43	L 9 Go	VR3			
44	2 1 1L	Incremental plot VR3			
45	L 7 Go	VR1			
46	2 1 1L	Incremental plot VR1			
47	L 8 Go	VR2			
48	2 1 1L	Incremental plot VR2			
49	D +	Return Type Ball			
50	L 16 Go	t			
51	A 6 Go	$t + \Delta t$			
52	C 16 Go	$t = t + \Delta t$			
53	1 +	Decrement and test counter			
54	Retain	End			
	Retain 2+				
1	L 16 Go	t			
2	D 17 Go	t/RC			
3	M 11 Go	-t/RC			
4	EXP	e to the (-t/RC) power			
5	M 11 Go	-e to the (-t/RC) power			
6	A 12 Go	1 -( )			
7	M O Go	V1(1 -( ))			
8	A 3 Go	V1(1 -( )) + VC			
9	Retain	End			

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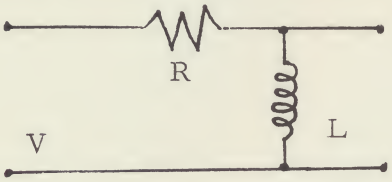
PLANNING SHEET

STEP NO.	OPERATION	COMMENT	SCRATCHPAD ASSIGNMENTS NO.	SYMBOL	CONTENTS
	Retain 3+	Enter and Type Data			
1	9 7 Go	Set Step 7			
2	9 0 +	To 0			
3	1 13 +	Set Counter No. 1			
4	Input	Key in Variable			
5	D +	Return Type Ball			
6	Type	Type Variable			
7	C 0 Go				
8	8 7 Go	Modify Step 7			
9	8 1 +	By 1			
10	1 +	Decrement and Test Counter No. 1			
11	Retain	End			

APPLICATION NOTE NO. 12
RL CIRCUIT ANALYSIS

Given an RL circuit



R = 1.5 ohms
L = 5.3×10^{-3} henrys
V = 120 volts
ω = 60 c.p.s.

Find

1. Reactance $XL = 2\pi\omega L$
2. Impedance $Z = R^2 + X^2$
3. Phase angle $\tan \theta = X L/R$

   $\theta = \arctan X L/R$
4. Power factor $\cos \theta = R/Z$
5. Current $I = V/Z$
6. Inductor Voltage $VL = IXL$
7. Resistor Voltage $VL = IR$
8. Power Dissipated $P = VI \cos \theta$

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PDS 1020 INTERPRETER PLANNING SHEET

PROBLEM: A. C. CIRCUIT ANALYSIS

STEP NO.	OPERATION	COMMENT
1	Inp	enter R (ohms)
2	C 1 Go	
3	Inp	enter L (henrys)
4	C 2 Go	
5	Inp	enter V (volts)
6	C 3 Go	
7	Inp	enter (c.p.s.)
8	C 4 Go	
9	M 6 Go	2ω
10	M 5 Go	$2\pi\omega$
11	M 2 Go	$2\pi\omega$ = XL
12	C 7 Go	
13	TYPE	XL
14	M 7 Go	XL^2
15	C 16 Go	
16	L 1 Go	
17	M 1 Go	R^2
18	A 16 Go	$XL^2 + R^2$

SCRATCHPAD ASSIGNMENTS

NO.	SYMBOL
1	R
2	L
3	V
4	ω
5	π
6	2
7	XL
8	Z
9	tan θ
10	θ
11	P.F.
12	I
13	VL
14	VR
15	P
16	Temporary XL^2

PDS 1020 INTERPRETER PLANNING SHEET

PROBLEM: A. C. CIRCUIT ANALYSIS

STEP NO.	OPERATION	COMMENT	SCRATCHPAD ASSIGNMENTS NO.	SYMBOL
19	SQRT	$\sqrt{XL^2 + R^2} = Z$		
20	C 8 Go			
21	TYPE	Z		
22	L 7 Go	XL		
23	D 1 Go	XL/R = tan θ		
24	C 9 Go			
25	TYPE	tan θ		
26	Arctan	compute θ		
27	C 10 Go			
28	TYPE	θ		
29	cos	compute P.F.		
30	C 11 Go			
31	TYPE	P.F.		
32	L 3 Go			
33	D 8 Go	V/Z = I		
34	C 12 Go			
35	TYPE	I		
36	M 7 Go	IXL = VL		
37	C 13 Go			
38	TYPE	VL		
39	L 12 Go			